

REMARKS

In the Office Action dated March 24, 2006, a restriction was required between Invention I, claims 1-4, 6-18, 36-42 and 43-51, drawn to a process for casting metal and a process for reducing the cooling time of a metal that has been cast, and Invention II, claims 25, 27 and 29-35, drawn to a mold for the casting of metals. Affirmation of an election of Invention I was required and the claims of Invention II were withdrawn from consideration. Claims 36 and 42 were provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 16 and 22 of co-pending application Serial No. 10/614,601. Claims 1-4, 7-9, 12, 15-17, 36, 37-41, 43, 45 and 51 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Japanese Patent Document No. 59-156566 (Japanese '566) in view of U.S. Patent No. 4,971,134 to Kawaguchi et al. (Kawaguchi), in further view of U.S. Patent No. 6,551,396 to Pineda et al. (Pineda). Claim 6 and 44 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Japanese '566, Kawaguchi and Pineda in further view of either Japanese Patent Document No. 61-245938 (Japanese '938) or U.S. Patent No. 6,416,572 to Eldemallawy et al. (Eldemallawy). Claims 10, 11, 13, 14 and 46-50 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Japanese '566 in view of Kawaguchi and Pineda, in further view of U.S. Patent No. 5,158,130 to Sahari or U.S. Patent No. 5,915,452 to Conroy et al. (Conroy). Finally, claims 18 and 42 were rejected as being unpatentable over Japanese '566 in view of Kawaguchi, Pineda and Carter. For the reasons outlined in detail below, it is respectfully submitted that the pending claims are in condition for allowance over the art of record.

Restriction

During a telephone conversation with the undersigned, a provisional election was made without traverse to prosecute the invention of Group I, claims 1-4, 6-18, 36-42 and 43-51. Applicants hereby affirm this election. Since claims 25, 27 and 29-35 were withdrawn from further consideration by the Examiner as being drawn to a non-elected invention, applicants take this opportunity to cancel those claims, without prejudice to their reintroduction in a divisional application.

Double Patenting

Claims 36 and 42 were provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 16 and 22 of co-pending application Serial No. 10/614,601. However, this was only a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented. If and when applicants receive a notice of allowance concerning claims 16 and 22 of application Serial No. 10/614,601, applicants will at that point submit a terminal disclaimer concerning claims 36 and 42 of the instant application.

Independent Claim 1 and Dependent Claims 2-4 and 6-18

Claims 1-4, 7-9, 12 and 15-17 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Japanese '566 in view of Kawaguchi and Pineda. Japanese '566 was said to substantially teach the claimed rapid cooling in a lost wax casting method for casting metal which comprises the use of simultaneous molten metal pouring and forming a partially solidified metal casting, including a solidified metal shell, by using controlled mist-like cooling water spraying on the mold containing molten metal, for the purpose of forming a fine grain solidified metal shell and reducing defect for the casting. It was admitted that Japanese '566 fails to teach the use of removing the mold.

Kawaguchi was said to teach the use of removing the mold after a solidified metal shell in the mold is formed and strong enough to contain the rest of the molten metal but before the molten metal contained in the shell has been completely solidified, for the purpose of reducing casting defects. It was then stated that it would have been obvious to one having ordinary skill in the art to provide Japanese '566 the use of removing the mold as taught by Kawaguchi, in order to further improve the quality of the casting and reduce defects. It was also admitted that Japanese '566 in view of Kawaguchi fails to teach the molding method.

It was then asserted that Pineda teaches the claimed molding method, a water dispersible mold and method of investment casting for metal by using the mold, comprising the use of a water soluble binder, including phosphate and silica sand having lower heat diffusivity than metal for the purpose of coating a pattern, and forming a water dispersible mold and casting metal by an investment casting method. Pineda was further said to teach the use of dropping the mold into water to create a heat differential to crack a portion of the

mold. Pineda was also said to teach the use of controlling and reducing binder and increasing silica sand or filler for the purpose of making the investment softer and easier to remove it from the cast metal. It was then asserted that it would have been obvious to one having ordinary skill in the art to provide Japanese '566, in view of Kawaguchi, the use of a molding method as taught by Pineda in order to reduce cycle time of the casting and refine the cast grain size by partially removing water cooled mold parts of the water dispersible mold. This rejection is respectfully traversed.

Applicants first point out that Japanese '566 and Kawaguchi do not pertain to aggregate molds. In this regard, it is noted that both the Japanese '566 document and Kawaguchi specifically disclose metal molds. Note Figure 5 of Japanese '566 wherein a metal cross section mold is shown. Figure 4 similarly shows a metal cross section. Also, in Kawaguchi, a metal mold is evident from numerous figures, such as Figures 3, 11, 12, 19, 24, 27-32, 35-38, 40-42, 47, 49, 50 and 52-54. In each figure, a metal cross section is shown. Moreover, Kawaguchi states that the mold 1 is formed from a copper chromium alloy (see column 10, lines 11-13; column 13, lines 8-9; column 16, lines 49-50; column 20, lines 1-2) or copper or copper alloy (see claims 3, 11, 15, 22 and 24). Such molds are termed "permanent molds" in the art.

Applicants submit herewith a Section 132 Declaration by co-inventor Professor John Campbell. The Section 132 Declaration was filed in connection with co-pending application serial number 10/614,601. It may be recalled that the '601 application was also mentioned in connection with the double patenting rejection discussed above. Professor Campbell states that in the case of metal molds, such as those shown in Kawaguchi and the Japanese '566 patent document, including mold-types referred to as "permanent molds", it is common for the mold to be opened prior to the complete solidification of the casting. This is widely known, perfectly well understood and practiced in permanent mold foundries and die-casting shops all over the world. Therefore, the disclosure of such a mold in the Kawaguchi patent or in the Japanese '566 document is not remarkable (see paragraph 6 of the Campbell Declaration). Professor Campbell notes that the early opening of such a metal mold is advantageous in order to achieve better productivity for a casting (see paragraph 7 of the Campbell Declaration). However, neither Japanese '566 nor Kawaguchi pertain to aggregate molds.

In this connection, it is noted that claim 1 recites a process for the casting of metals

comprising forming a mold from an aggregate comprising a particulate material and a binder and removing at least a part of the mold, including at least a part of the aggregate prior to complete solidification of the molten metal into a casting. As Professor Campbell states, he is unaware of any method for removing an aggregate mold while the casting is still at least partially molten. He notes that such a practice would probably be dangerous in an aggregate mold because the lower temperature gradient, as a result of the less severe cooling than occurs in a metal mold, the casting does not build up such an effective solidified shell as it does in a metal mold. In fact, for many alloys, particularly many non-ferrous based alloys, that have a high thermal conductivity, the temperature gradient in the casting is so low that liquid can remain at the casting surface until the final moments of solidification.

As he notes, it would thus be unthinkable for a mold containing aggregate material to be removed prematurely, i.e., prior to complete solidification, especially if the fluid used to remove the mold is water. All casting education focuses on the extreme danger of mixing molten metal and water (see paragraph 9 of the Campbell Declaration). Thus, neither of the applied references teach a process for the casting of metals that employ a mold, including an aggregate, and in which at least a part of the mold is removed, including at least part of the aggregate, prior to complete solidification of the molten metal into a casting.

To reject independent claim 1, the Examiner also employed Pineda. Pineda is pertinent to investment casting employing an investment powder. Thus, Pineda does not disclose a metal mold unlike Japanese '566 or Kawaguchi. However, in Pineda, the molding material is packed into the cavity of the mold and then the casting and the mold are allowed to cool. Only once this has been accomplished is the mold broken and the casting is removed and trimmed (see column 1, lines 61-65). Thus, in Pineda, only after the casting has cooled and only after the mold itself is allowed to cool (see also column 6, line 24) is the mold removed. Such removal is by grinding, sand blasting or the like (see column 6, line 25). What is clearly missing from Pineda is any teaching or disclosure of removing at least a part of the mold, prior to complete solidification of the molten metal in the mold into a casting.

It is respectfully submitted that it would not have been obvious to combine the metal molds shown in Japanese '566 and Kawaguchi with the investment casting mold shown in

Pineda and arrive at the claimed process for casting metals, including forming a mold from an aggregate comprising a particulate material and a binder and removing at least a part of the mold, including at least a part of the aggregate, prior to complete solidification of the molten metal into a casting, as is recited in claim 1. Thus, claim 1 is in condition for allowance over the applied three way combination, as well as the remainder of the cited art.

Dependent claims 2-4, 7-9, 12 and 15-17 merely further patentably define the detailed subject matter of their parent claim or each other. As such, these claims are also believed to be in condition for allowance over the art of record.

Dependent claim 6 was rejected over Japanese '566, Kawaguchi and Pineda in further view of either Japanese '938 or Eldemallawy. In this connection, it was stated that Japanese '938 and Eldemallawy both teach the use of an amount of a heat resistant and microporous or microsphere oxide, such as pumice or perlite for the purpose of improving casting, shaping quality and mold removability. It was then stated that it would have been obvious to one having ordinary skill in the art to provide Japanese '566, in view of Kawaguchi and in further view of Pineda, the use of an amount of heat resistant and porous microsphere oxide, such as pumice or perlite as taught by Japanese '938 or Eldemallawy in order to effectively improve casting shaping quality and mold removability.

Applicants respectfully submit that it would not have been obvious to add porous microspheres to the metal molds of Japanese '938 or Kawaguchi. As to Pineda, this reference deals with investment castings. While it might be conceivable to add a glass, ceramic or refractory hollow sphere-like material to the particulate material used in the Pineda investment mold, Pineda only teaches the removal of the mold after not only the casting, but the mold itself has been allowed to cool. This has been mentioned above. Thus, even the asserted combination of Japanese '938 or Kawaguchi with Pineda would not result in the claimed process. Moreover, it would not have been obvious to combine the metal molds of Japanese '566 and Kawaguchi with the Pineda investment composition, for the reasons outlined in detail above. Thus, claim 6 is also believed to be in condition for allowance over the applied four way combination, as well as the remainder of the cited art.

Claims 10, 11, 13 and 14 were rejected as being unpatentable over Japanese '566 in view of Kawaguchi and Pineda in further view of either Sahari or Conroy. It was

admitted that Pineda, in view of Japanese '566 and Kawaguchi, fails to teach the use of controlling the dose of binder or the use of a water nozzle. Sahari was said to teach the use of water nozzles and submerging the mold into water for the purpose of cooling and removing the casting and for reusing the binder agent. Conroy was said to teach the use of nozzles and flow rate and pressure of fluid including water and surfactant for the purpose of removing cores from castings. It was then stated that it would have been obvious to one having ordinary skill in the art to provide Japanese '566, in view of Kawaguchi and in further view of Pineda, the use of a water nozzle as taught by Sahari or Conroy in order to control cooling the casting in the molten state and remove or crack the water soluble mold from the casting. This rejection is respectfully traversed.

While Pineda, Sahari and Conroy all deal with aggregate type molds, Japanese '566 and Kawaguchi do not. Thus, the use of Sahari for its teaching of water jets and submerging the mold into water for the purpose of cooling the casting and reusing the binder agent or the use of Conroy and its teaching of nozzles and flow rates and pressures of fluid including water and a surfactant for the purpose of removing cores from castings is inapposite. In other words, there is no purpose for employing water jets for removing the metal molds of Japanese '566 and Kawaguchi. And, there is no binder agent to be reused. Moreover, it would not have been obvious to one having ordinary skill in the art to somehow combine the metal molds of Kawaguchi and Japanese '566 with the investment composition of Pineda or the granular molding material of Sahari or the ceramic cores of Conroy. As a result, it is respectfully submitted that dependent claims 10, 11, 13 and 14 are in condition for allowance over the art of record.

Dependent claim 18 was rejected as being unpatentable over Japanese '566, Kawaguchi and Pineda, in further view of Carter. It was admitted that Japanese '566, Kawaguchi and Pineda fails to teach the use of rapid cooling of the molten metal including lowering the mold into a solvent bath. Carter was said to teach the use of rapid cooling, such as simultaneous molten metal pouring and immersion cooling for the purpose of forming a fine grain and reducing oxidation pitting for the casting. It was then stated that it would have been obvious to one having ordinary skill in the art to provide Japanese '566, in view of Kawaguchi and Pineda, the use of rapid cooling of the molten metal, including lowering the mold into a solvent bath as taught by Carter in order to reduce cycle time of the casting and refine the cast grain size by partially removing water cooled mold parts of

the water dispersible mold.

As has been previously noted, Carter particularly teaches the immersion of its shell mold 20 into its bath 22 “until the molten metal therein solidifies and preferably for some time interval thereafter”, since this “is important in the practice of the invention” (see column 3, lines 48-51). Thus, Carter particularly teaches that his shell “must be self supporting in the sense that it can be moved into a liquid coolant” (see column 4, lines 32-34). Carter further teaches that his poured mold, with the metal in it still in a fluid condition, should be immersed in the body of liquid 22 and it should be maintained in the liquid until the molten metal solidifies (see column 3, lines 26-27). Thus, Carter fails to teach a process for the casting of metals, including removing at least a part of a mold, including at least a part of the aggregate, prior to complete solidification of the molten metal into a casting.

Applicant’s submit that it would not have been obvious to combine the teachings of Carter, in which the mold is only removed after the casting is completely solidified and which teaches a particulate mold, with the teachings of Japanese ‘566 or Kawaguchi that pertain to a metal mold which is removed while the casting is only partially solidified. As a result, it is respectfully submitted that claim 18 is in condition for allowance over the four way combination of references, as well as the remainder of the cited art.

Independent Claim 36 and Dependent Claims 37-42

Claims 36-41 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Japanese ‘566 in view of Kawaguchi and Pineda. Claim 36 recites a method for forming a casting from a molten metal comprising the steps of forming at least a part of a mold from an aggregate, comprised of a particulate material and a soluble binder, removing at least a part of the mold, including at least a part of the aggregate, and solidifying and cooling at least a part of the molten metal to form a casting. As noted previously, Japanese ‘566 and Kawaguchi deal with metal molds, not aggregate molds and Pineda deals with an investment composition. For the reasons noted above, it is respectfully submitted that they cannot be reasonably combined to render claim 36 unpatentable. As a result, claim 36 patentably defines over the applied three way combination of references, as well as the remainder of the cited art.

Dependent claims 37-41 merely further patentably define the detailed subject matter

of their parent claim. As such, these claims are also believed to be in condition for allowance over the art of record.

Dependent claim 42 was rejected over the combination of Japanese '566, Kawaguchi, Pineda and Carter. Claim 42 recites the steps of contacting at least a part of the mold with a solvent, removing at least a part of the mold, solidifying and cooling the molten metal to form the casting, and wherein all of these steps are performed by lowering the mold into a bath of solvent. While Carter does disclose lowering its mold into a bath of liquid, this is not done for the purpose of dissolving the mold but, rather, for the purpose of cooling the metal "until the molten metal therein solidifies and preferably for some time interval thereafter", since "this is important in the practice of the invention" (see column 3, lines 48-51). Thus, Carter does not remove at least a part of the mold via lowering the mold into a bath of a solvent. In Carter, the liquid is not employed as a solvent. Moreover, it would not have been obvious to combine the metal molds of Kawaguchi and Japanese '566 with the investment composition of Pineda and the Carter mold to perform the method recited in claim 42. As such, claim 42 is also in condition for allowance over the art of record.

Independent Claim 43 and Dependent Claims 44-51

Claims 43, 45 and 51 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Japanese '566 in view of Kawaguchi and Pineda. Claim 43 recites a process for the casting of metals comprising forming a mold, contacting the mold with a solvent including water, cooling a shell of solidified metal formed at an interface of the molten metal and the mold with the solvent and removing at least a portion of the mold with the solvent while molten metal remains within the shell. It is respectfully submitted that claim 43 is patentable over the applied three way combination. More particularly, there is no solvent employed in the metal molds of Japanese '566 and Kawaguchi. Also, there is no solvent employed with the investment composition mold of Pineda. Thus, in none of these three references is there any teaching of a process in which at least a portion of the mold is removed with a solvent, while molten metal remains within the shell. Therefore, claim 43 is in patentable condition over the applied three way combination, as well as the remainder of the cited art.

Claims 45 and 51, which merely further patentably define the detailed subject matter

of their parent claim or each other are also believed to be in condition for allowance over the art of record.

Claim 44 was rejected over Japanese '566, Kawaguchi and Pineda in further view of Japanese '938 or Eldemallawy. Claim 44 recites the method of claim 43 wherein the mold comprises a particulate material, including a mixture of hollow microspheres, cenospheres or pumice, silica sand and a binder. As noted previously, it would not have been obvious to take the metal molds of Japanese '566 or Kawaguchi and replace them with the aggregate material taught in Japanese '938 or Eldemallawy. More importantly, even the applied five way combination of references neither teaches nor discloses the method recited in claim 44. Therefore, claim 44 is also believed to be in condition for allowance over the art of record.

Claims 46-50 were rejected as being unpatentable over Japanese '566, Kawaguchi and Pineda in further view of either Sahari or Conroy. For the reasons outlined in detail above, it is respectfully submitted that even the applied four way combination of references does not render unpatentable any of dependent claims 46-50. As such, these claims are also believed to be in condition for allowance over the art of record.

Applicant takes this opportunity to submit new independent claim 52. Claim 52 recites a process for the casting of metals comprising the steps of forming a mold from an aggregate comprising a particulate material and a binder; delivering a molten metal into the mold; contacting the mold with a solvent; dissolving at least a part of the binder; and, removing at least a part of the particulate material of the mold, prior to complete solidification of the molten metal into a casting.

It is respectfully submitted that claim 52 patentably defines over any of the art of record, including any of the patents applied against the claims hereinbefore discussed, in any combination.

Applicants also submit herewith new dependent claims 53 - 60. These claims merely further patentably define the detailed subject matter of their parent claim. As such, these claims are also believed to be in condition for allowance over the art of record.

In view of the foregoing, it is respectfully submitted that all of the pending claims are in condition for allowance over the art of record. Such allowance is earnestly solicited.



Respectfully submitted,

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June 16, 2006
Date

CERTIFICATE OF MAILING

Under 37 C.F.R. § 1.8, I certify that this Amendment is being

- ☒ deposited with the United States Postal Service as First Class mail, addressed to: MAIL STOP AMENDMENT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date indicated below.
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